IN-SPACE PRAYER TIMES CALCULATOR

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This report is submitted in partial fulfillment of requirements for the award of Bachelor of Electronic Engineering (Telecommunication Electronics) with honours

Fakulti Kejuruteraan Elekronik dan Kejuruteraan Komputer
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Tajuk Projek : IN-SPACE PRAYER TIMES CALCULATOR

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For my beloved parents, Mr. Ibrahim Yaacob and Mrs. Badariah Siman, my siblings, my supportive supervisor, Mr. Azmi Awang Md Isa and my dearest friends.

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ABSTRACT

In 'Rukun Islam', Muslims are compulsory to perform 5 prays everyday, no matter where they are. In conjunction with Malaysia's astronaut program, where astronauts will be sent to the International Space Station (ISS) in the October, 2007, developing a prayer time calculator becomes essential to determine the prayer times and the direction of Qib'lat or Kaabah to aid the Muslims astronauts in performing their duty. The prayer times and the direction of Qib'lat are based on falaq or celestial sphere. Because of the condition in space is different, they are extremely difficult to be determined due to the high velocity of the space vehicle, its orientation and the direction of travel. Mathematically, the prayer times for any given location of a spacecraft orbiting the Earth can be determined if the latitude and the longitude of the location are known. Nevertheless, it is a lengthy process. By using software development, the Visual Basic.NET software can alleviate much of this tedium. The written software program will be integrated in a small hand held devices, which is the Personal Digital Assistant. This project will be an innovative prayer times calculator to help Muslims to perform their duty in space.

ABSTRAK

Dalam Rukun Islam, umat Islam diwajibkan menunaikan solat fardhu 5 waktu setiap hari, tidak kira di mana mereka berada. Bertepatan dengan program angkasawan Malaysia, angkasawan akan dihantar ke Stesen Angkasa Antarabangsa (ISS) pada bulan Oktober 2007. Oleh itu, penghasilan kalkulator waktu sembahyang adalah sangat diperlukan untuk menentukan waktu sembahnyang dan arah Kiblat bagi membantu angkasawan yang beragama Islam menunaikan kewajipan mereka. Waktu sembahyang dan arah Kiblat yang ditentukan adalah merujuk kepada ilmu falaq. Disebabkan keadaan di angkasa lepas berbeza dengan di bumi, waktu sembahyang dan arah Kiblat menjadi sukar untuk ditentukan disebabkan oleh kelajuan pergerakan, orientasi dan arah pergerakan kapal angkasa. Secara matematik, waktu sembahnyang pada mana-mana kedudukan kapal angkasa yang mengorbit bumi dapat ditentukan jika longitud dan latitudnya diketahui. Walaubagaimanapun, ia merupakan proses yang rumit. Dengan menggunakan pembangunan perisian, iaitu Visual Basic.NET, hampir keseluruhan daripada kerumitan ini dapat dikurangkan. Perisian program yang telah lengkap akan diintegrasikan dengan 'Personal Digital Assistant', iaitu alat peranti kecil. Projek ini akan menjadi pengira waktu sembahyang yang inovatif untuk membantu umat Islam menunaikan sembahyang di angkasa lepas.

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INTRODUCTION

This chapter will discuss and explain about the project background, the objective, the scope of project and the problem statements.

1.1 PROJECT BACKGROUND

New inventions of the electronic devices such as digital electronic, mobile phone and notebook grow in a steady stream so do the Personal Digital Assistant (PDA). In the recent years, it was originally designed as a personal organizer but yet has become much versatile over the years. It has been widely used in many fields, such as medical, science, education and sports.

This project idea came out when there is an astronaut program organized by the Malaysia government, where two astronauts will be sent to the International Space Station.

This system is developed to enable the Muslims astronauts to perform their duty in space, since they are totally in different condition, where the velocity and altitude of the spacecraft has changed the method of calculating the prayer time. The information of the prayer time and the direction of Qib'lat can be obtained easily from the PDA.

This project is divided into two major parts, which are the hardware and the software. The major part is the hardware, consists of PDA and PC as the controllers. The system's programming output and interface will be displayed on the PC monitor whereas only the system's interface for the PDA. The hardware will let the users know the prayer times and the direction of Qib'lat. From this information, the users will know the present and becoming prayer times, which enables them to manage their time in space for pray. For software part, the Visual Basic.NET interfaces the hardware and software, which will then combine together as a complete project. The Graphical User Interface (GUI) also will be provided by this software. This project is more preferred to Muslim astronauts in space to aid them perform the prayers.

1.2 PROJECT OBJECTIVES

This project is carried out on the following objectives:

a) To study and investigate the orbital propagator (Two Line Elements and SGP4) on a 3D celestial sphere for determination of propagating and the direction of Qi'blat in space, i.e. in Low Earth Orbit (LEO).

b) To develop and innovative prayer times calculator that can determine and predict the prayer times and the direction of Qi'blat for a spacecraft orbiting the Earth.

c) To apply this prayer time calculator in software in the Windows Mobile Pocket PC as a mobile device and can be used by the astronauts effectively.

1.3 SCOPE OF WORK

The scope of work for this project is divided into four parts:

a) Implement the orbital mechanic's knowledge based on the program time that focusing on Low Earth Orbit (LEO) and spacecraft orbiting the Earth in less that 225 minutes, which uses the SGP4 as the orbital propagator.

b) Calculate the prayer times based on falaq or celestial sphere, where the sun angle and azimuth direction to Ka'abah are the considered criteria. Also, the latitude and longitude of any given location of spacecraft orbiting the Earth are used in calculation.

c) Develop a software for Windows Mobile Pocket PC using Visual Basic.NET, where all the prayer times calculation are written and produced a graphical user interface in developing the software.

d) Implement the developed Windows Mobile Pocket PC into the hardware, the Personal Digital Assistant (PDA).

1.4 PROBLEM STATEMENTS

Basically, the International Space Station (ISS) orbiting the Earth in 15.6 times or around 16 cycles a day with 91.8 minutes per cycle at the speed of around 7.6 km/s and at the altitude of about 360km above the Earth surface.

In this case, all the 5 prayer times appear for each cycle. Since there are 16 cycles to be completed a day, there are 16 prayer times that will be appeared inside the ISS. It should be noted that there are only 5 prayer times a day for Muslims to perform.

In order to find the solution of this problem, where there are a total of 80 prayer times (5 prayer times x 16 orbits) a day, it may use some calculation. The start and end of prayer times and the opportunity of the prayer times will be based on these theologies:

a) Determine the fraction of each prayer time in one orbit
b) Multiply the fraction of each prayer time with 24 hours

1.5 SYSTEM OPERATION

From the block diagram that shown below, the software package that developed started from the literature review. Then, the VB.NET software programming is learned before program designing. The completed program is then integrated into the Personal Digital Assistant (PDA).

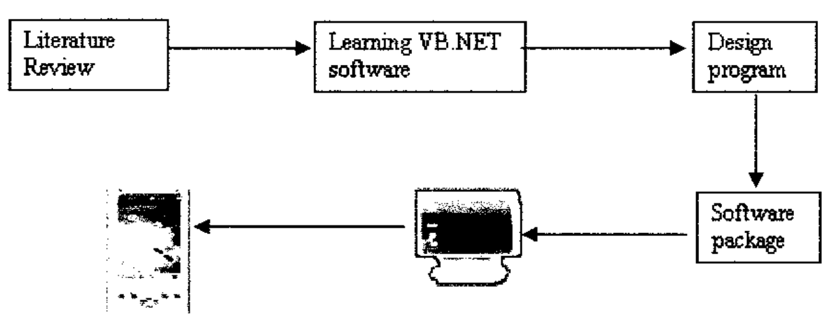

Figure 1.1: Overall Block Diagram of the PDA Interface

1.6 REPORT STRUCTURE

In this thesis report, there are five chapters written. Chapter one is about the introduction. It narrates the overview of the project including objective, problem statement and scope of project, system operation and report structure. At the second chapter, it discusses about the literature review regarding the project. At third chapter, it talks about the methodology of the project. In chapter four, it focuses on result and analysis of the project. For the last chapter, it contained the discussion of the project and conclusion.

CHAPTER II

LITERATURE REVIEW

This chapter will discuss about the projected earth and Qib'lat pole concept, prayer time mapping, falaq or celestial sphere knowledge, the space station, the NORAD two line elements, the orbital elements, the SGP4 propagator, the orbits and launching methods, the Low Earth Orbit (LEO), the latitude and the longitude and the Personal Digital Assistant (PDA).

2.1 OVERVIEW

In the planning stages for years, construction of the International Space Station began with the launch of the U.S.-owned, Russian-built Zarya control module on November 20, 1998, from the Baikonur Cosmodrome in Kazakstan.

Next, the Space Shuttle Endeavour launched from the Kennedy Space Center, Florida, on December 4, 1998. It carried the U.S.-built Unity connecting module. Unity and Zarya were connected by Endeavour's crew during a 12-day mission to begin the International Space Station's orbital construction.

In June 1999 with Discovery made the third ISS mission, supplying the two modules with tools and cranes. This was followed in May of 2000, by the Shuttle Endeavor, whose crew performed maintenance tasks and delivered supplies in preparation for the arrival of the Zvezda Service Module.

The Russian-provided crew living quarters, Zvevda (Russian for Star) arrived on July 25, 2000, becoming the third major component of the International Space Station. Now, the ISS was nearly ready for its crew. In September of that same year, the shuttle Atlantis visited the International Space Station to deliver more supplies and prepare Zvezda for the International Space Station's first permanent crew. October saw the historic 100th shuttle mission, as Discovery delivered the Z1 Truss, Pressurized Mating Adapter 3 and four Control Moment Gyros. Finally, on November 2nd, Expedition One, the first crew arrived to take their places aboard the International Space Station.

As the first crew closed out the twentieth century aboard the International Space Station, the final shuttle mission of the century arrived. The Endeavour's five-member crew installed a set of solar arrays.

The first International Space Station mission of the twenty-first century, in February, 2001, had Atlantis and her crew deliver the US Destiny Laboratory Module, as well as moving the Pressurized Mating Adapter 2 from the end of Unity to the end of Destiny for future shuttle mission use.

Since then, there have been several other crews manning the International Space Station.

Additional modules installed include 2 Multi-Purpose Logistics Modules Leonardo and Raffaello, the International Space Station's robot arm, called the Space Station Remote Manipulator, the International Space Station's joint airlock, and finally, the Russian Docking Compartment, known as Pirs (Russian for pier).

2.2 FALAQ OR CELESTIAL SPHERE KNOWLEDGE

In general, the cosmic dimension of the Islamic rites especially the daily prayers brought into focus the practical importance of astronomy for the religious community. The times of the daily prayers have to be determined throughout the year for every geographical latitude and longitude where there are faithful, practicing Muslims and the direction for the prayers facing to Ka'abah has to be determined again for every locality where the prayers are performed. Taking into account the radius of the Earth, we expand the radius from 6378 km to 6678 km indicating that the spacecraft orbiting the Earth at 300 km above the surface of the Earth with period of approximately 90 minutes.

The path of the Sun moving around the Earth is basically called the ecliptic plane. The movement of Sun around the ecliptic plane is essential knowledge before we can go further to calculate the daily prayer time. Moreover, the movement of Sun is always changing from one day to another day during a year. We can observe that the position of the Sun during sunrise at the east and sunset at the west always changing during a year. There is some season that the position of the Sun during sunrise and sunset is from northerly and some season that the position of the Sun during sunrise and sunset is from southerly as shown in Figure 2.1.

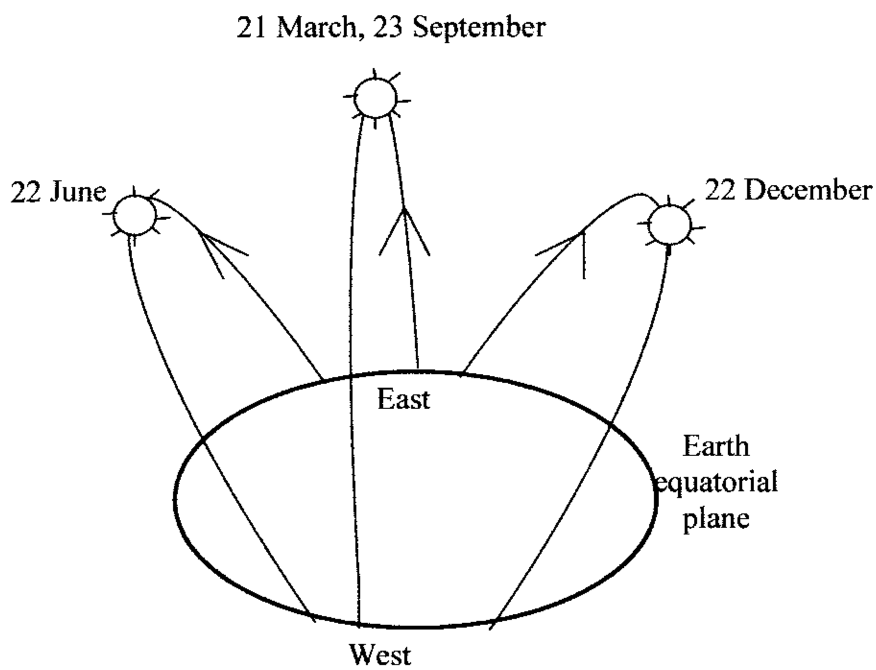

Figure 2.1: The Position of the Sun during Sunrise and Sunset in a Year

Table 2.1: Angle of the Sun With Respect To the East-West Plane

Date	Angle of the Sun
21 March	0°
22 June	23.5°
23 September	0°
22 December	-23.5°

Sunrise occur at the east point two times in a year at 21 March and 23 September at equator. Similarly for sunset at the west point. The sun will move accurately at zenith and no shadow for straight object can be observed at midday for both days. Zenith is the point vertically above an observer, 900 from the horizon. Midday can be defined as the instant when the center of discus of the Sun crossing local meridian. Local meridian is defined as the line from the north to the south through zenith. The Sun will rise to the

22 June. At this day, the Sun will not move above our head and it will be far at northerly. After 22 June, it will move to the south and crossing the equator again at 23 September. After that, the sun will continue to move to the south from the east point. Table 2.1shows the angle of the Sun with respect to the east-west plane during a year.

2.2.1 Determination of Prayer Time

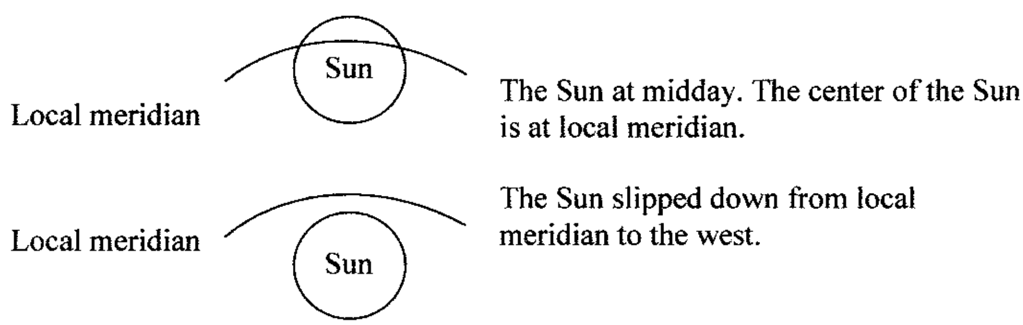

Figure 2.2: The Sun Passing through the Local Meridian

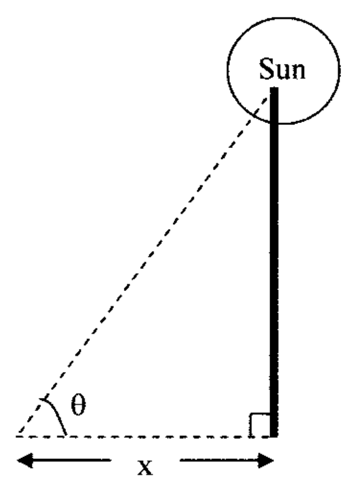

Figure 2.3: Shadow Length x at Midday

During day, the Sun will move from the east horizon crossing local meridian and continue to the west horizon. Zuhr prayer time will begin at the instant when all discus of the Sun passing through the local meridian as shown in Figure 2.2. In other words.